ESA-012-2 Dow Chemical Company – Freeport Site
PUBLIC REPORT

Introduction:
Dow Chemical Company's Texas operations at Freeport is the largest Petrochemical complex among all the Dow sites in the USA & around the world. Its Freeport site has 3 plants namely, A, B & Oyster Creek plants. These units produce over 50 basic and specialty chemicals. Natural gas & Electricity is used as a raw material (feed stock) in addition to use as utility. These sites generate their own electricity in addition to meeting their steam need.
Vinyl Chloride monomer (VCM) is a popular raw material to the Polymerization industry. Dow Chemical is one of the premier manufacturers of VCM. Ethylene Di Chloride Cracking Furnaces are the largest Natural gas users in VCM manufacturing.

Objective of ESA:
To provide U.S. industries technical assistance targeted to reduce fuel expenditure.

Focus of Assessment:
The focus of Energy (Steam) System Assessment (ESA) is as follows: (1) to train in-plant personnel to continue and sustain the improvement and (2) to identify energy waste reduction opportunities. This ESA is focused on the Process Heating Systems studying the EDC cracking furnaces.

Approach for ESA:
USDOE qualified specialist provided training to the plant engineers in the use of USDOE PHAST Tool and helped them in completing an initial assessment using the PHAST model developed for one of the cracking furnaces.

General Observations of Potential Opportunities:
General Observations

The primary energy consumption in the VCM process occurs in the EDC cracking furnaces. There is also some electrical demand used to drive blowers and pumps.

Potential energy saving opportunities

With the help of plant's engineering team, DOE's Process Heating assessment during May-07 has identified the following potential opportunities to reduce natural gas usage: They are classified as Near, Medium & Long term opportunities as defined below:

- Near term opportunities would include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.
- Medium term opportunities would require purchase of additional equipment and/or changes in the system. It would be necessary to carryout further engineering and return on investment analysis.
- Long term opportunities would require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.

1. Reduce oxygen content of flue (exhaust) gases:

The cracking furnaces are provided with 2 *On-line* Oxygen analyzers at 2- locations in their flue gas duct. During the ESA the flue gas Oxygen levels were observed and found to vary between 2 % and 3.8% in these furnaces. The flue gas Oxygen content is being monitored continuously and they have brought it down from 6% few years ago to the present levels above. Further reduction in Oxygen levels is possible, if unburned fuels in flue gas also could be monitored. Hence it is recommended to install *On-line* combustibles (or CO analyzers) also in the flue gas duct after the last heat recovery section and to trim the excess air levels further down. It is possible to maintain 1.5% to 2.0% Oxygen in the flue gas streams of these furnaces without sensing any Combustibles.

Maintaining the Oxygen at an average of 1.8% in the flue gas streams of these furnaces would save $ 118,200. (Near term)

2. Use of flue or Exhaust gas heat for combustion air preheating:

The furnaces were designed and installed in 1994, when the natural gas price was hovering quite low around $3.00 per MMBtu. The observed average stack temperatures in the EDC furnaces varied between a low of 426^{o}F to a high of 461^{o}F. These temperatures match to the design stack temperatures of about 425^{o}F – 450^{o}F that was corresponding to the optimum stack losses at that fuel cost. However the fuel cost has doubled since then and it would be worth to reconsider the optimum stack losses at the present fuel cost.

The PHAST model was used to evaluate the stack losses by reducing the average stack temperature from the present level of 426^{o}F to a target average level of 306^{o}F. Reducing the stack temperature to an average level of 306^{o}F would reduce the stack losses in the furnaces by approximately 3.4%.

An Air- Preheater installation near the existing stack of each furnace and to route the heated combustion air to the Convection section burners would accomplish the suggested heat recovery. The details for this Heat Recovery project could be developed by engineers who have the suitable experience in Furnace operations & design.

Reducing the fluegas temperature to an average of 306^{o}F in the flue gas streams of these furnaces would reduce the stack losses by 3.4% and save $ 706,700. After deducting the additional cost of Fan power consumption the net savings would be $682,800 annually. (Long term)

3. Proper insulation and maintenance of furnace structure or parts

The house keeping levels at VCM 5 is good resulting in only few identifiable hot surfaces at the EDC cracking furnaces. Surface temperature measurement with the non-contact temperature gun identified some hot spots (over 250^{o}F) at the sides of the radiant section & the cross over ducts of the one of the furnaces. A dedicated insulation survey could identify more areas of improvement. Adding a layer of Ceramic fiber veneering modules at the radiant section of the EDC furnaces could bring down the wall losses, due to its lowering the overall thermal mass. A 10^{o}F reduction in surface temperature would result in 0.09% reduction in wall losses. Adding a high emissive ceramic coating at the radiant zone could also be considered as an alternative / additional option.

Reducing the outside surface temperature by an average of 10^{o}F from the present level would reduce the wall losses by 0.1% and save $ 16,500. (Medium term)

Management Support and Comments:

Dow Chemical is a global leader in better management of its facilities with high performance standards. A corporate level energy usage reduction goal of 25% by the year 2020 is already announced. The corporate level energy management group is working on this goal and encourages the site teams to focus on efforts that reduce the natural gas & other energy usage at all the Dow Chemical plants located around the country. The Dow Freeport's site team has shown great enthusiasm towards reducing the natural gas cost of their plant. They indicated that some of the above ESA recommendations would be taken up for further review and implementation as they implemented similar energy cost savings projects in the past under the 'Six-Sigma' program.

DOE Contact at Plant/Company:

Mr. Richard E Kaus, 979 238 1944. rekaus@dow.com
Manufacturing Engineer
2301 Brazosport Blvd.
Building. OC-501,
Freeport. TX 77541